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January 17, 2003

Mr. Bobby Lutfy, Hydrogeologist
North Carolina Dept. of Environment and Natural Resources
Division of Waste Management - Solid Waste Section
1646 Mail Service Center
Raleigh, NC 27699-1646

RE: MRR of High Point, LLC
Proposed Construction and Demolition Debris Landfill
Response to Comments on Site Application and Construction Plan Application
JEI Project 600.00, Task 06

Dear Bobby,

The purpose of this letter is to provide responses to the comments regarding the Site Application (which includes the Hydrogeologic Report and Groundwater Monitoring Plan) and Construction Plan Application for the referenced facility that were outlined in your letter dated November 4, 2002. The comments from this letter are provided below in italics followed by our responses. This letter and the associated attachments are provided in a format that allows for incorporation into the original report binders for Volume One – Section II. All other binders will be resubmitted in their entirety.

<u>Volume One - Site Application - Section I</u>

1. ***There is a discrepancy in the property boundary for a portion of land on the northwest side of the property, adjacent to the City of High Point MSW Landfill property. Drawing Number 3, The Quarter-Mile Radius Map, and the Property Survey Plat in Appendix 1, do not include this portion of property within the facility boundary.***

   Replacement Drawing No. 3 and replacement Appendix 1 with the corrected facility boundary have been included as attachments to this letter.

2. ***Drawing 2, the Two-mile Radius Map: The scale used for this drawing is not consistent with the scale required by Rule .0504 (l) (b). There is no reference to "significant ground-water users" within the two-mile radius. It is difficult to locate some of the***

"potential or existing sources of ground-water and surface water pollution" on the drawing.

Replacement Drawing No. 2 has been included as an attachment to this letter. The scale has been revised as required to 1inch = 1000 feet, "significant groundwater users" have been added to the drawing, and clarification of the locations of "potential or existing sources of groundwater and surface water pollution" have been made.

3. ***Drawing 3, the Quarter-mile Radius Map: Rule .0504(1) (a) requires both an aerial photograph and a blueprint. The blueprint showing wells, watercourses, dry runs, topography, etc. is missing. The limits and types of zoning are not clear in some locations. The zoning along Riverdale Road for the northeast portion of the site still indicates "Residential" use. Was this not reclassified to accommodate the MRR C&D Landfill?***

Zoning information has been verified and the zoning limits have been revised on replacement Drawing No. 3. The zoning along Riverdale Road for the northeast portion of the site was reclassified in October 2001 to accommodate the MRR C&D Landfill and changes on the drawing have been made accordingly. To meet the requirements of Rule .0504 (1) (a), Drawing No. 8, the Quarter-Mile Radius Topographic Map, is being submitted with this letter and should be inserted into the site application. This drawing contains the required information for the "blueprint" of the aerial photograph, showing wells, watercourses, dry runs, and topography. The dry runs are not indicated on the map, but are apparent based on topographic features. Drawing No. 8 has the same scale and shows the same area as Drawing No. 3, the Quarter-Mile Radius Map.

4. ***There are some discrepancies regarding buffers. Although Drawings 4 and 5 indicate a minimum of 500 feet of buffer will be allowed from waste and residences, the Drawings actually show less than 500 feet from waste to the edge of several of the residences. If any of these residences have wells, this also will need to be evaluated. The Application states that there are plans to purchase some of the near-by residences and demolish them. Verification of this will be necessary before the proposed conceptual design could be approved.***

The 500-foot buffer has been extended to the closest edge of the residence to the edge of the proposed waste limits. Residential well locations have been identified on the enclosed Drawing Nos. 4 and 5. The purchase of 9 residences on the North and East of the property boundary are under contract as of the drafting of this response (closing set for early February) and are scheduled for demolition to maintain the site buffer as future expansion occurs.

5. ***Portions of the site have less than the generally required 200-foot buffer from the waste boundary to the facility boundary. This buffer is needed to effectively monitor ground-water quality at the facility and ensure adequate room for water quality***

assessment and remediation, if needed. The Drawings indicate that with berms and erosion control devices, some areas have less than 50 feet remaining that could be used for monitoring and possible assessment and corrective action.

The limits of waste boundaries have been adjusted to ensure the 200-foot buffer with the property boundary at all points. In accordance with the City of High Point's Development Ordinance, Low-density Option, a 50-foot buffer/setback is allowed for all other construction, exclusive of the screening berm. There is adequate room in the 200-foot buffer for well monitoring and water quality assessments and remediation activities that might be required.

6. ***Drawings 5,6, and 7 should be clearly identified as being "Conceptual" drawings. The Grade Elevation Contours need to be clearly indicated on Drawing 6.***

These drawings have been modified to comply and are included with this submittal.

7. ***Appendix 5 - Soil Testing Results: On "The Laboratory Test Data Summary" sheet, the USCS Classification, #40 Sieve, #100 Sieve, and #200 Sieve data appear to be incorrect for Sample Number P-1.***

A replacement "Laboratory Test Data Summary" prepared by Trigon Engineering Consultants, Inc. is included as an attachment.

<u>Volume One - Site Application - Section II</u>

8. ***One of the most critical items that influences "site suitability" is the ability to effectively monitor ground-water quality at the site. Aquifers that are mostly in the bedrock are very difficult to monitor effectively, since it is difficult to predict ground-water flow patterns in fractured bedrock. In about half of the piezometers at this site the water was encountered in the bedrock. In a number of other piezometers it appears likely that water may be limited to the bedrock during seasonal low water table conditions. Therefore further evaluation is needed of the seasonal low, as well as the seasonal high, water table conditions.***

If ground-water flow is predominantly in bedrock, then a better understanding of the fractured bedrock flow is needed. At the old Riverdale Road sanitary landfill, just down the road, dikes and faults are known to have a great influence on ground water flow patterns in the bedrock. From what I have been able to determine, the geology of the proposed MRR C&D site is somewhat transitional from that found at the old Riverdale Road Sanitary Landfill site and that found at the current Kersey Valley MSW Landfill site.

We agree that, in general, groundwater monitoring of a site where the uppermost aquifer occurs in bedrock, can be challenging due to the difficulty in predicting fracture flow pathways. However, the hydrogeologic investigation of the site (including the supplemental information provided in this letter) has sufficiently characterized the subsurface conditions, and provided adequate information to allow for effective monitoring of groundwater and surface water for a potential release from the disposal facility. Our hydrogeologic characterization of this site indicates that seasonal high water table is below the top of bedrock in localized areas of the site, primarily on the topographic highs. A detailed analysis of this condition for the Phase 1 area is presented on Drawing No. 7A, where the uppermost aquifer occurring in bedrock is distinguished from the areas where it occurs in saprolite and partially weathered rock (PWR). As this analysis is based on the seasonal high water table, the water table/bedrock intersect line would be expected to migrate downslope to varying degrees during relatively dry periods.

As can be seen in the Groundwater Monitoring Plan, our proposed downgradient groundwater monitoring points for the facility are located in areas where the uppermost aquifer occurs in saprolite, and thus will be monitoring 'dispersive' flow from the proposed waste unit.

Several hydrogeologic conditions exist related to the concern for areas where the uppermost aquifer occurs in bedrock. As discussed during a meeting in your office on January 2, 2003, bedrock at the proposed site is relatively competent, with few fracture flow pathways. Given the competence of this rock it is expected that a significant amount of *interflow* occurs in the unsaturated zone, thus limiting the amount of aquifer recharge occurring in the bedrock aquifer areas of this site. As discussed in Fetter[1] (Applied Hydrogeology, Second Edition, 1988, p. 38) ...

> *If the unsaturated zone is uniformly permeable, most of the infiltrated water percolates vertically. Should layers of soil with a lower vertical hydraulic conductivity occur beneath the surface, then the infiltrated water may be move horizontally in the unsaturated zone. This* ***interflow*** *may be substantial in some drainage basins and contribute significantly to total streamflow. Thin permeable soil overlying fractured bedrock of low permeability would provide a geologic condition contributing to significant interflow.*

This condition further substantiates the effectiveness of the proposed monitoring network. Several hydrogeologic conditions have been identified that support our conclusion that the site can be adequately monitored. These conditions are summarized below.

- Bedrock at this site is very competent, as demonstrated during the drilling of approximately 170 feet of rock, including 55 feet of core. Twelve piezometers have been drilled and screened entirely in bedrock. Nearly half of these have hydraulic conductivity (K) values in the range of 10E-08 cm/sec. Supporting data are provided on Tables 1, 2, and 5. Even accounting for the steep gradients on site, this low hydraulic conductivity value for bedrock equates to flow rates of approximately 1 foot

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1 *Fetter, C.W. 1988. Applied Hydrogeology – Second Edition, Merrill Publishing Company, Columbus, OH, p. 38.*

per year in the competent rock. The flow rates for the overlying PWR and saprolite zones are on the order of 20 to 90 feet per year. These two hydrogeologic zones have similar aquifer characteristics, and constitute the zones where the majority of groundwater and groundwater flow occur. Water infiltrating through the saprolite, including the discontinuous clay-rich horizons that locally cause accumulation of water in the unstaurated zone, reaches the water table and flows within the PWR/saprolite zone on top of competent bedrock, to the groundwater discharge areas. Based on the relatively thin PWR layer and the competency of the underlying bedrock, minimal recharge into the fractured bedrock aquifer is expected. Supporting flow rate data are provided on Table 7 and Drawing No. 7A.

- Well P-15D is located at the triple-junction of three drainages. During drilling of this well subsurface conditions were monitored closely in an effort to choose a water-baring fracture across which to place the well screen. Such interval was not encountered and the well took approximately two to three months to stabilize, indicating minimal groundwater occurrence in the bedrock portion of the aquifer. Of additional note is the fact that a significant upward gradient exists in this well, as demonstrated by artesian conditions. On December 30, 2002, the water level in this well was 2.1 feet above ground surface.

- This part of the Carolina Slate Belt is characterized by intrusions of mafic dikes. In some cases these dikes constitute the majority of the rock mass (Carpenter, 1982; reference provided in report). These intrusives are apparently of the same general age as the Paleozoic country rock. Unlike Triassic age diabase that was intruded several million years after the county rock formed, creating extensive fracturing, the mafic dikes identified on this site appear to be of concern only in the saprolitic horizons where differential weathering creates inhomogenity. Based on our observations in twenty test pits at the site, it is apparent that the inhomogeneities are primarily pegmatitic veins and mafic dikes ranging up to 2 feet in width. These units are generally fractured, creating very localized impacts on basin interflow and groundwater flow.

- As you know, we conducted a magnetometer survey of the site as a supplement to the intrusive subsurface investigative activities, to further characterize the hydrogeologic conditions of the site with respect to siting a C&D facility. Our field staff spent three days in the field traversing this site with a magnetometer and failed to identify significant linear magnetic anomalies. This fact is demonstrated by the somewhat unusual pattern of anomalous, or relatively high, magnetic readings displayed on Drawing No. 2. Our review of the data suggests that there are several areas of the site with relatively high magnetic signature. However, these areas are not characterized by linear anomalies characteristic of significant diabase dikes.

- Inspection of the site outcrops, rock core, and topography indicate that there are no significant lineaments in the site area. Outcrop and rock core fracturing and jointing was very limited (refer to discussion in 3.3.2 in the text, and RQD data provided on Table 2.). Three of the primary drainages on site appear to be related to the regional northeastern strike of the Carolina Slate Belt as opposed to bedrock structural features.

In conclusion, we believe that groundwater at the site can be effectively monitored without the need for any extraordinary or unusual measures. The Hydrogeologic Report and Groundwater Monitoring Plan present a thorough characterization of this site and an effective program to monitor groundwater and surface water.

9. ***The references at the bottom of page 1 and in the first paragraph on page 2 should be to the tributary to Richland Creek, rather than to the Deep River.***

Both references have been changed to Richland Creek in the attached text revisions.

10. ***On the bottom of page 7, the trend of the dikes should be northeast southwest, rather than northwest southeast.***

The text has been modified to indicate a north-south/northeast/southwest orientation for the dikes.

11. ***Page 9: Because of the unusual condition described of saturated soils occurring above the water table, it is important that saprolitic soils with different hydraulic properties be characterized separately. The clay-sands apparently have different properties from the silt-sands.***

During the initial drilling program, hydrogeologic conditions were observed within the saprolite unit that suggested localized accumulation of water in the shallow unsturated zone. As described in the text, a follow-up test pit investigation was performed to further assess these conditions. A sandy clay horizon was noted in several borings and test pits generally within the upper 5 feet of the borings/excavations. This sandy clay horizon has a distinct mottled appearance, and is therefore easily distinguished in the field within the saprolite unit, based on visual observation. However, due to the discontinuous nature of the sandy clays at the site, this unit was not characterized as a separate hydrogeologic unit, but rather characterized as part of the saprolite unit. This grouping is further supported by the soil test data that were collected for these clay-rich horizons. As stated in the text, the laboratory data for soils from the sandy clays are indistinguishable from the silty/sandy soils. It is apparent that these horizons are a factor in the interflow pathways that govern groundwater movement in the saprolite unit; however, their overall properties do not warrant that they be distinguished as a separate unit. The revised Table 6 included with this submittal has a breakdown of the data for the sandy clays. Further, we have identified this horizon on the revised cross sections (Drawing Nos. 6 and 6A).

12. ***On the middle of page 10, the statement regarding the relationship of effective porosities to the weathering profile is confusing. Typically effective porosities increase with depth thru the weathering profile as the soils become coarser, and then decrease in the fractured bedrock.***

This statement has been revised to suggest that, typically, effective porosities increase with depth through the weathering profile as the soils become coarser, and decrease with the transition to competent bedrock. We note that our aquifer analysis data (Table 5), although somewhat limited for PWR, indicate that there is not a *significant* increase in hydraulic conductivity for this unit. However, as noted on Table 6A, the effective porosities estimated for this unit are much higher for the PWR unit than for the Bedrock unit. The increased flow through the PWR unit is also evident in the groundwater velocity calculations shown on Table 7.

13. ***Normally site-specific effective porosity estimates are made based upon the soil grain size analyses for each of the different soil units (clay-sand, silt-sand, PWR, etc.).***

Specific yield values were calculated by estimating the percentage of clay material in a sample by using a direct correlation to the liquid limit, which was provided in the laboratory results in Appendix 5 – Soil Testing Results. A guide sheet for determining percent clay from liquid limit is provided[2]. A percentage of sand-sized material was taken from the gradation results from the laboratory soils analysis. From these correlations, the relative percentage of silt-sized material could be determined. The relative percentages of clay, silt, and sand in P-1, -13, -14, and -15D were applied to Johnson's[3] *Textural Classification Triangle for Unconsolidated Material* to obtain approximate specific yield values. On this triangular plot samples from piezometers P-2 and -3 fall into the range of "*Sandy Clay–Area of No Samples*"; therefore, a specific yield value could not be obtained. A copy of the triangular plot is attached for reference. An appoximate value for effective porosity was then obtained using a direct correlation from the specific yield. Values obtained for piezometers P-2 and P-3 were estimated using total porosity values obtained from existing laboratory data from site soil samples. An expected range of effective porosity was obtained from these total porosity values[4]. Data utilized for effective porosity calculations have been included as Table 6A.

14. ***The statement at the top of page 11 that "the granite that underlies the site appears to be highly competent, with very few if any fractures beneath the upper 15-20 feet" would appear to indicate monitoring fractured bedrock ground-water flow below these depths would be very difficult.***

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2 *www.mn.nrcs.usda.gov/mo10/mo10guides /liquidlimit.html*

3 *Johnson, A.I., Specific Yield --- Compilation of Specific Yields For Various Materials: U.S. Geological Survey Water Supply Paper 1662-D.*

4 *Freeze, R.A. and Cherry, J.A. 1976. Groundwater, Prentice-Hall, Englewood Cliffs, N.J.*

This issue is addressed in the response to comment number 8.

15. ***At the end of the first paragraph on page 11, the statement that "In areas where diabase dikes are in contact with the granite, the fracture intensity is predicted to be much greater" would seem to indicate the possibility of preferential ground-water flow through these zones.***

The referenced statement has been removed from the text. As stated in the response to comment number 8, our review of the geophysical data suggest that there are several areas of the site with relatively high magnetic signature. However, these areas are not characterized by linear anomalies characteristic of significant diabase dikes.

16. ***In the discussion on "Unsaturated Zone Water Accumulation", beginning on page 12, there seems to be strong evidence that some unusual conditions occur at the site, however it is still not clear exactly what is causing the phenomenon, how extensive it is, and most importantly how to predict accurately what seasonal high water table conditions are likely to be. On the one hand, the descriptions in the Test Pit Logs indicate water bleeding into the pits from sand-clay soils located in the upper three to five feet of the pit profile. On the other hand, at most locations the resulting stabilized water levels in the test pits are higher than the water tables in the nearby piezometers. This would seem to complicate the ability to accurately predict actual seasonal high water table conditions. This does not directly affect "site suitability", however it does affect the design.***

As described in section 3.4.2 of the text and as shown in the cross sections (Drawing Nos. 5, 5A, 6 and 6A), the water levels in the test pits were well above the true water table. The water levels in the test pits never stabilized. The water levels fluctuated significantly in response to a combination of precipitation events and interflow through this zone. The water levels in the four piezometers that were constructed within this zone (P-4A, -13S, -16 and -17) stabilized over a short time period, then changed significantly as test pits were excavated nearby and the water was drained from the piezometer into the test pit. This localized, near-surface, zone of water accumulation is not a significant issue with regard to the ability to monitor the site since landfill construction will remove much of the affected soils. The true water table levels observed in the majority of the piezometers, in addition to the four new piezometers and the evaluation of historical groundwater and precipitation data from the area, provide sufficient information to determine seasonal high water levels.

17. ***On the middle of page 13, the statement that "dikes and quartz veins locally capture and channel percolating water" would seem to indicate that these features could provide preferential flow pathways in both the saturated and unsaturated zones of the uppermost aquifer system.***

This issue is addressed in the response to comment number 8. Additionally, based on test pit observations, some of the dikes and veins do locally capture and channel percolating water in the saprolite. However, this phenomenon is not expected to significantly alter the site-wide groundwater flow paths. This conclusion is supported by the fact that the majority of the dikes and veins are very small (generally less than 2 feet wide) and highly fractured. As observed, the primary impact of these features is in locally accelerating and/or re-directing the percolation of water in the unsaturated zone. The discontinuous nature of these features negates a significant impact on the site-wide flow regime as it relates to the ability to effectively monitor groundwater.

18. ***The bottom of page 13 seems to indicate it would be difficult to predict fractured bedrock ground-water flow paths. This would make ground water monitoring difficult if the aquifer is mostly in the bedrock, especially if this is the case where monitoring wells are needed.***

This issue is addressed in the response to comment number 8.

19. *Site-specific effective porosity values representative of each distinct lithologic (hydrogeologic) unit are needed for the ground-water velocity calculations on page 14.*

Site-specific porosity values have been calculated for the three hydrogeologic units and were used in the revised groundwater velocity calculations provided on the revised Table 7 and Drawing No. 7A.

20. ***On the bottom of page 15, it is not clear why "The fracture zones associated with these dikes are interpreted to have little significant impact on groundwater flow". This seems inconsistent with earlier comments in the Report.***

This issue is addressed in the responses to comments number 8, 15 and 17.

21. *Section 3.5 - "Site Suitability": A better understanding of "Diabase Dikes", faults, and fractures may be necessary to predict ground-water flow in the bedrock aquifer if most of the aquifer (especially in the areas requiring monitoring) is in the bedrock. Although a better understanding of the "Unsaturated Zone Water Accumulation", "Vertical Separation From Bedrock", and "Vertical Separation From Seasonal High Water Table" are needed for the site, these items affect primarily design considerations, and not "Site Suitability".*

This issue is addressed in the responses to comments number 8 and 52.

22. *First paragraph on page 18: Based on Drawing No. 2, it would appear that the WW-1 and the associated structures, rather than WW-2, would need to be abandoned to enable site development. If this is the case, and the WW-2 dwelling has public water, is well WW-2 also to be abandoned?*

This paragraph has been modified to clarify your concerns. Both wells and their associated structures will be abandoned prior to or during construction activities for the reclamation pad (WW-2) or disposal phases within a 500-foot radius (WW-1).

23. ***On the middle of page 19, the reference to the trends for the dikes appears to be inaccurate.***

The text has been modified to indicate a north-south/northeast-southwest orientation for the dikes.

24. ***Page 19 and following - "Groundwater Monitoring Plan": Evaluation of the proposed monitoring system will be delayed until there is a better understanding of some of the questions regarding site suitability, monitorability, extent of aquifer that occurs in the bedrock, and bedrock ground-water flow.***

Additional data and discussion associated with your concerns are provided in this response.

25. ***Pages 22 and 23. Solid-waste Section policy, following the lead of EPA, only requires the purging of three to five well casing volumes. While the Section does not object to the purge rate calculations proposed, it should be noted that this goes beyond what is normally required by the Section.***

We have modified the calculations and associated text to reflect 3 well casing volumes.

26. ***Page 24. Copies of the Field Log Sheets should be routinely submitted as part of the report for each semi-annual sampling event.***

The text has been modified to reflect this request.

27. ***Page 26. Borings at solid waste landfill sites should not be abandoned with soil cuttings.***

Four very shallow borings (6 to 12 feet in depth - all terminated above the water table) were abandoned with a combination of bentonite and cuttings, with the exception of the initial boring for P-4. This boring, drilled to a depth of 6 feet below ground surface, collapsed while pulling augers from the hole to a depth of 4 feet below ground surface. The remaining 2 feet was grouted with neat cement. Boring B-2, drilled to a depth of 12 feet, was backfilled with bentonite to a depth of 3 feet below ground surface and the remaining hole was filled with cuttings. Boring B-3, drilled to a depth of 6 feet, was backfilled with bentonite to a depth of 2 feet below ground surface and the remaining hole was filled with cuttings. Boring B-5, drilled to a depth of 10 feet, was backfilled with bentonite to a depth of 3 feet below ground surface and the remaining hole was filled with cuttings.

28. ***Pages 26 and 27 - Surface Water Monitoring: Surface water sampling is needed upstream and downstream on each of the two streams forming the northwest and southwest boundaries for the proposed landfill areas. The downstream sample on the southwest boundary stream needs to be located below any potentially impacted area from all proposed landfilling activities.***

Drawing No. 8 and the correlating text on pages 26 and 27 have been modified to include the additional surface water monitoring points. The location of the downstream monitoring point for the larger (northwest-southeast) creek has also been moved further downstream in order to establish background at a point that would also be appropriate for any future phases of the landfill.

29. ***Table 1: According to the Boring Log, the depth to Top Of Bedrock for piezometer P-6 should be 8.5 feet.***

The table displayed a depth of 9 feet due to a spreadsheet formatting error (i.e., the spreadsheet cell was not formatted to show decimal places). However, the bedrock elevation data presented in the table are correct. The revised table is attached.

30. ***Table 2: None of the rock cores appear to be in locations having diabase dike materials.***

Several exposures of diabase exist in the area streams providing data for accurate characterization. Additionally, test pits T-1A, T-1B, T-1C, T-4, T-5, T-10, and piezometer P-11 were excavated/drilled in the area of magnetic anomalies. Soils characterized in the above explorations were largely granitic saprolite indicating that the anomalies may or may not be associated with diabase intrusion. As stated in our text, we believe these areas are likely associated with dike swarms rather than prominent linear features. A revised Table 2 complete with rock core data from newly installed P-19 and P-20 is attached.

31. ***Table 4: The Bedrock Elevation and Groundwater Elevations for T-12 described as <771.50 do not appear consistent with the Test Pit Log.***

The exact locations of test pits were not surveyed. The location for T-12 was determined to be incorrect, which accounts for the inconsistencies in elevations. The test pit ground surface elevation has been corrected to be 780 feet MSL. The corresponding bedrock elevation (<772 feet MSL) and groundwater elevations have been updated. None of these changes significantly impact the contours as shown on Drawing Nos. 3 or 4. However, for consistency, the revised Table 4 and the boring log for T-12 (to replace the log in Appendix 1) have been corrected and are attached.

32. ***Table 5: It is not clear how the Saturated Aquifer Thickness Values were determined, especially for piezometers P-4A, P-7, and P-12. The Screen Length for P-7 appears to be incorrect. How was the "geomean" calculated? (My calculations indicated a different result.) There does not appear to be any hydraulic conductivity values representative of dike materials. No data is provided for the Phase 1 area. Some of the matches to the curves in Appendix 5 do not appear to be the best matches.***

As you are aware, saturated aquifer thickness values are difficult to quantify in the Piedmont due to the transitional aquifer properties between saprolite and bedrock. Fortunately, the sensitivity of this variable is low in calculations of hydraulic conductivity. For example, on a representative slug test for piezometer P-15S, the aquifer thickness was changed from 10 to 100 to 1,000 feet with the following changes in the resultant hydraulic conductivity values: 1.379 E-04, 1.249 E-04, and 1.166 E-04 cm/sec. Thickness values were assumed to be fairly consistent throughout the site area and were chosen based on the water column for each well. They ranged from 15-30 feet for piezometers screened in saprolite/PWR and 25-90 feet for piezometers screened in bedrock. The aquifer thickness values depicted on the individual Aquifer Analysis of P-3, -4A, -6, -7, -9, and -15S were found to be inconsistent with Table 5 and have been corrected (the revised slug data for <u>all</u> of the tests are included as replacement pages for Appendix 5). A correct screen length of 10 feet for P-7 was shown in the Aquifer Analysis documentation in Appendix 5 and Table 5 has been corrected to reflect this value. The geometric mean was calculated using the following formula:

$$\text{Geometric Mean} = \sqrt[n]{y_1 y_2 y_3 \ldots y_n}$$

Several hydraulic conductivity values were obtained both immediately upgradient and downgradient of the Phase 1 area (within 100-150 feet of Phase 1) in piezometers P-9, -12 and -15S, which were determined to be the most crucial areas for data collection for monitoring purposes. Additional slug tests were performed for two of the newly installed piezometers, as well as P-13D, all of which are within or near the proposed Phase 1 footprint. These data are included in the revised Appendix 5 and Table 5, and are consistent with site-wide values.

As we have stated elsewhere, the impact of diabase on the groundwater flow regime appears to be limited. Magnetic anomalies are not associated with site-wide linear features. Given the nature and occurrence of diabase and the other mafic dikes observed on site it would be very difficult to obtain accurate values of hydraulic conductivity through traditional slug testing. The units are generally very thin and/or fractured. As you are aware, slug tests are designed for determining conductivity in porous media and provide only qualitative data in competent and fractured bedrock.

Concerning the slug test analyses, the software used in the aquifer analysis automatically calculates best fit matches to the generated Bouwer and Rice curves. These curves are a representation of an average best fit line through the data including beginning and ending points. Attempts were made to omit data that may be unreliable at the very beginning of each test, as the aquifer was initially disburbed when the slug was introduced or removed from the test well. These graphs were reanalyzed excluding additional data in order to make the best fit line appear to more closely resemble the Bouwer and Rice curve. However, these revisions produced relatively small changes in hydraulic conductivity values and the resultant values are not considered to be more representative of actual aquifer conditions than the original values. Thus, no changes were made to the final graphs.

33. ***Table 6: The support documentation in Appendix 9 would appear to indicate the USCS Classification for P-1 should be SC-SM. The #10 thru #200 sieve Gradation Results for P-1 is not correct. What is the source for the permeability data for piezometers P-2 and P-3?***

The classification and the #10, #40, #100 and #200 sieve gradation results for P-1 have been changed in both Appendix 9 and Table 6. The permeability values for P-2 were derived from laboratory testing of an undisturbed (i.e., Shelby tube) sample, and those for P-3 were derived from a large-volume bulk sample.

34. ***Table 7: Site-specific hydraulic characteristics (hydraulic conductivity, porosity, and effective porosity) should be provided for each distinct lithologic (hydrogeologic) unit, and these values should be used in the ground-water velocity calculations. It would be better to use at least one more significant figure for the gradient values.***

The site-specific hydraulic conductivities and effective porosities for each of the three hydrogeologic units have been used in the groundwater flow velocity calculations as shown on attached revised Table 7. As stated in the response to comment number 11, the clay-rich horizons were not characterized as a separate hydrogeologic unit. The gradient values have been modified to include two decimal places.

35. ***Table 8: The Vertical Gradient for 05/23/02 appears to be incorrect. No vertical gradient information is provided for the P-13 piezometer nest. Only the saturated portion of the shallow well screen should be used for establishing the Distance Between Screen Midpoints.***

The gradient for 05/23/02 has been corrected. No vertical gradients were calculated for the P-13 nested piezometer pair because the shallow piezometer is not screened across the water table; therefore, the results would not be reflective of a true vertical gradient. The distance between midpoints was recalculated using the mid-point of the saturated portion of the shallow well for each of the dates as shown on the updated Table 8. Also, new data from 12/30/02 were incorporated into the table. There were no significant changes to the calculated gradients based on these data.

36. ***Table 9: The 1994-2001 Average is incorrect. It should be 40.65 inches, which is below the longer term 1931-2001 average. Since the 1994-2001 Average is lower than typical, a more conservative evaluation of Seasonal High Water Table conditions needs to be done.***

As you stated, the average for 1994-2001 was miscalculated and should be 40.65 inches. During the last 4 months of 2002, the rainfall totals were well above normal (approximately 1 foot above monthly averages). Therefore, for the entire year of 2002, the rainfall (measured at the Piedmont Triad International Airport) was approximately equal to the 70-year average. Additional rainfall data were gathered from Martin Marietta's rock quarry, which is located less than one mile north of the site. These data indicate that the rainfall totals for 2002 are well above the long-term precipitation average near the site, which is also shown on the revised Figure 6. It is important to note that the rainfall data collected at the quarry are a conservative estimate of actual rainfall, given that data were not normally collected on weekends. Given these conditions, it was inferred that the fall 2002 water levels are at or above the seasonal high. Table 9 has been updated to reflect these changes.

37. ***Table 10: On what basis were the "Adjustment for Seasonal High" values established? Site-specific data comes from the spring of 2002, approximately four years into a drought of historic proportions. Further evaluation of Seasonal High Water Table conditions is needed. This is not only relevant to the vertical separation requirements, but will also be useful in evaluating whether water levels normally occur in saprolite or bedrock at various locations in the site.***

As stated in the text and shown on the table in Appendix 11, the adjustments for seasonal high groundwater estimates were based on eight years of historical data from the adjacent Kersey Valley Landfill. The topographic and hydrogeologic settings for each of the wells at the Kersey Valley site were examined and the differences from mean groundwater elevations for each well were determined. Based on these data, a conservative (i.e., approximately double) seasonal high water table adjustment was chosen for each of our site wells based on similar topographic and hydrogeologic considerations. The process by which this was performed is discussed in detail in section 3.5.1.4.

In light of the fact that April 2002 water levels were collected during drought conditions, additional water levels from the Kersey Valley site were collected and incorporated into the revised table for this site, which is to be included in Appendix 11. These results show slightly higher averages (for differences from means) for all wells. However, the seasonal high adjustments are still conservative based on these data. Similar data for the nearby White Street Landfill in Greensboro, NC were also evaluated using a similar technique. Data from pre-drought conditions through early 2001 were available and are also included in Appendix 11. The same conclusions can be drawn from these data, that the seasonal high adjustments used for the site are very conservative.

It is also important to note that the seasonal high adjustments are in agreement with the groundwater elevations collected for site wells in November 2002. As shown in Table 10B, the predicted values are either approximately equal to or below the predicted seasonal high values, with the exception of P-13D. The seasonal high adjustment for this well has been changed to 6 feet and the corresponding map and base grades have been changed accordingly. Additional stabilized water levels from the four recently installed piezometers were also used in the seasonal high calculations and revised map. The corresponding drawings (Drawing Nos. 6, 6A, 7 and 7A) have been modified to reflect these changes.

Moreover, as outlined in our revised text, the seasonal high adjustments are based on water levels collected during an unseasonably wet period of time. The water levels collected in November 2002 followed several above average rainfall events that had recharged the relatively shallow aquifer present on site.

38. ***Table 11: This Table will be evaluated at a later date.***

This table has been revised based on the changes outlined in the response to comment number 44.

39. ***Table 12: As previously questioned, will WW-1 or WW-2 or both be abandoned?***

Table 12 has been modified to include WW-1 and WW-2.

40. ***Drawing No. 2: It is not clear how the Areas Of Magnetic Anomalies were delineated based upon the limited number of transects described in Appendix 4.***

Areas of known diabase and granite (i.e., outcrops) were analyzed with the magnetometer prior to conducting the survey to determine a range of readings representative of each rock type. A base station was chosen to check for day-to-day fluctuations in the background magnetic field (strength). Based on data from outcrops and regional diabase trends, it was inferred that dikes should have a general north-south trend. A total of 10 data collection transects oriented approximately east-west were established to maximize the potential for encountering anomalies. These transects are identified on Drawing No. 1 in Appendix 4. Given the linear nature of diabase it is assumed that features, if present, between these transects would be very small and insignificant as related to impacts on the groundwater flow regime. Magnetometer readings were taken every 25 feet along the transect to intersect anomalies (i.e., diabase dikes) that might be large enough to significantly alter groundwater flow. These readings were flagged and recorded in a field logbook. A baseline gamma reading was determined by graphic interpretation of the data, as well as data collected from known diabase and granite outcrops. Magnetic anomalies were revisited after all transects were completed. Magnetic highs were delineated by following the line of magnetic high readings and traversing back and forth using the cutoff concentration of 51,950 gammas as borders of the anomalies. Further details are available in Appendix 4.

As stated in our response to comment number 8, the site magnetometer survey failed to identify significant *linear* magnetic anomalies indicative of major diabase dikes. This fact is demonstrated by the somewhat unusual pattern of anomalous, or relatively high, magnetic readings displayed on Drawing No. 8. Our review of the data suggests that there are several areas of the site with relatively high magnetic signature. However, these areas are not characterized by linear anomalies characteristic of significant diabase dikes.

41. ***Drawing No. 3: The ground-water contours indicate that the boundary streams are not receiving ground-water discharge.***

Due to the fact that the property boundary line overlies the boundary streams, it is difficult to see the topographic contours. However, the groundwater contours do indicate discharge along these two streams. Slight adjustment was made to the 730 and 750 contours on Drawing No. 3 to emphasize the discharge. The northernmost reaches of the northeast-southwest boundary stream, which was dry on April 23, 2002, do not indicate groundwater discharge on this drawing. However, as shown on Drawing Nos. 7 and 7A, there is groundwater discharge further upstream during seasonal high conditions and the appropriate adjustments have been made to the 760 contour.

42. ***Drawing No. 6: Some of the data plotted on the cross-sections appears to be about two feet off. Some of the water table elevations, particularly for cross-sections B-B' and C-C', do not appear consistent with data in the tables. The cross-sections do not indicate that the boundary streams are receiving ground-water discharge. Water tables in a number of the Test Pits are above the potentiometric surface.***

The water table elevations and correlating contours (for April 23, 2002) as shown on cross sections B-B' and C-C' are consistent with the data shown in Table 3. The elevations for the piezometers and test pits that encountered water above the true water table are shown with the symbol indicated in the legend on Drawing No. 6. The cross sections have been modified slightly to show groundwater along the bottom 1 to 2 feet of the drainages. This is reflective of the very shallow water levels in the streams during the time of the investigation, and indicates groundwater discharge to the surface water features. The water levels shown in the test pits on the cross sections and in the correlating tables are not indicative of the true water table, as explained in detail in section 3.4.2 of the report.

43. ***Drawing No. 7: The ground-water contours indicate that the boundary streams are not receiving ground-water discharge.***

This issue is addressed in the response to comment number 41.

44. ***Drawing No. 8: Refer to previous comments. The proposed upgradient well is located in diabase dike material, while none of the proposed downgradient wells appear to be in diabase materials. Since the geochemistry could be different between the granitic and the diabase materials, the location of the background well should be reconsidered.***

The proposed location for MW-1 was within the area of a magnetic anomaly, which may or may not indicate the presence of diabase at that specific boring location. However, we concur that diabase may be present and have moved the proposed location approximately 125 feet to the northwest, as shown on the revised Drawing No. 8. This drawing has also been revised to replace the proposed location for MW-5, with the existing piezometer P-12. The associated monitoring well construction log is also attached to replace the one in Appendix 12.

45. ***Appendix 1: Partially Weathered Rock (PWR) appears to be defined somewhat differently in this Report compared to the definition normally used by the Solid Waste Section.***

The parameters used to establish the designation of PWR are defined in section 3.3.3.2 of the report. In general, the designation is based on the prominent fabric and unweathered mineralogy, in addition to standard penetration test data (i.e., an increase in blow counts) and/or down hole air hammer 'report.' Based on the available data, it is apparent that the PWR unit is relatively thin, with an abrupt transition into competent bedrock. As stated in the text, the hydrogeologic properties of this unit are similar to those for the saprolite unit, contrary to the widely accepted Piedmont hydrogeologic model. The only significant difference noted between the hydraulic properties for the PWR and the saprolite unit was the calculated effective porosity. The calculated effective porosities for samples from the PWR were slightly less than those calculated for the saprolite unit and significantly greater than those anticipated for the bedrock unit.

46. ***Appendix 4: As previously stated, it is not clear how the Magnetic Anomalies were mapped, based upon the limited number of transects done.***

This issue is addressed in the response to comment number 40.

47. ***Appendix 5: As previously stated, some of the match lines do not appear to be the best matches for some of the data curves.***

This issue is addressed in the response to comment number 32.

48. ***Appendix 8: The Rose Diagram appears to indicate a strong preferred orientation for Diabase Dikes at the site.***

We are in agreement that there is a preferred orientation to the north/northeast for the diabase dikes, as evidenced by outcrop measurements and as suggested by the site-wide magnetic anomalies.

As stated in our response to comment number 8, the site magnetometer survey failed to identify significant *linear* magnetic anomalies. This fact is demonstrated by the somewhat unusual pattern of anomalous, or relatively high, north/northeast trending magnetic readings displayed on Drawing No. 8. Our review of the data suggests that there are several areas of the site with relatively high magnetic signature. However, these areas are not characterized by clearly defined, continuous linear anomalies characteristic of significant diabase dikes.

49. ***Appendix 9: Refer to previous comments for Table 6. There does not appear to be any breakdown for the silt and clay fractions in the soils analyses.***

The particle size analysis that is required under Rule .0504(c)(i)(B) is not prescriptive in requiring the hygrometer (fines) analysis. However as demonstrated in our response to comment number 13, we are able to deduce with some accuracy the percentages of fines in our representative samples. In the event that further analyses are needed for any future landfill operations and/or environmental assessment activities, these data can be obtained at that time.

50. ***Appendix 11: Why is MW-9 classified as "MID" and MW-9D classified as "LOW"? Since the 1994-2001 data is below longer-term averages, a more conservative value than "Mean Elevation" may need to be chosen as the point of departure for the evaluation. Has the Spring 2002 data been evaluated, since this is taken at the same time as the site-specific data available? Has site-specific data been gathered since that reported for early June 2002?***

Both MW-9 and -9D at the Kersey Valley facility should have been classified as "LOW." The amended table is attached. Because our estimates were above those calculated for Kersey Valley, this change does not significantly affect the data. See responses to comment numbers 36 and 37 for further justification for seasonal high adjustments. The spring 2002 groundwater level data for Kersey Valley were unavailable at the time our original submittal was prepared. However, as noted in response to comment number 30, the spring and fall 2002 data for this site have been included in the revised table for Kersey Valley in Appendix 11.

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51. ***Drawing 3: Refer to previous comments regarding horizontal buffer requirements. Note especially that a minimum of 200 feet of buffer is required from the waste boundary to the facility boundary in the Phase 1 area.***

This issue is addressed in the response to comment number 5. All associated drawings have been modified accordingly.

52. ***Drawing 4: A major hydrogeologic concern regarding the design plan for Phase 1 is that there are insufficient piezometers to establish the vertical separation criteria in sufficient detail to design the base grades. The general rule of thumb for boring density is at least one boring per acre. There appear to be only two boring locations within the proposed 12.5-acre Phase 1 footprint.***

In response to this concern and as discussed during a meeting in your office on November 13, 2002, four additional piezometers were proposed for the Phase 1 area. Installation of these piezometers was completed on December 17, 2002. These additional points allow for more accurate determination of bedrock and water levels within the Phase 1 area. The bedrock and seasonal high water table maps, and area cross sections have been revised incorporating these data and all drawings have been revised to show their locations. The boring and well construction logs and well development logs are attached to be included in Appendix 1 and the survey plat to be included in Appendix 2.

53. ***Drawing 7: Regarding the cross-sections, refer to the previous comment regarding inadequate piezometer density in the Phase 1 area.***

This issue is addressed in the response to comment number 52 above.

54. ***Drawing 9: The sedimentation basin to the south of Phase 1 is located and designed in such a way as to interfere with effective ground water monitoring.***

In response to this concern we have relocated and redesigned the subject basin. The basin has been moved to a location approximately 95 feet southeast of its previous location. The revised location will mitigate the potential impacts from water table mounding that might occur following stormwater runoff.

55. ***Appendix 1: Refer to previous comments regarding the survey boundaries, especially for the triangle of land on the northwest side of the site.***

This issue is addressed in the response to comment number 1.

In closing, on behalf of Material Recovery and Reclamation of High Point, LLC, we would like to thank you for your attention to, and assistance with, this permit application. Your review comments were very thorough and helped in preparation of the enclosed revised application, which will benefit the facility during development of the waste disposal areas. Please call us if you have any additional issues that may be resolved by phone.

Sincerely,
JOYCE ENGINEERING, INC.

Daniel R. Moore, P.G.
Manager of Environmental Services

Mickle D. Elliott, P.E.
Senior Technical Consultant

Enclosures

C: F. Norbert Hector, Jr., MRR of High Point, LLC
Rachel P. Kirkman, P.G., JEI Project Hydrogeologist
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